Education Working Paper Series

Working Paper 4

Different kinds of disadvantage and school attainment

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Published by

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ISBN 978-0-907552-21-5

Abstract

This paper uses "effect" sizes, correlations, and a regression model to illustrate the links between different ways of assessing disadvantage at school and subsequent qualification outcomes at age 16 in England. Previous work has compared variables that represent current or recent snapshots of disadvantage with longer term summary variables and found the latter to improve measures of both segregation between schools and explanations of raw-score differences in attainment. This new work takes a more detailed longitudinal approach, modelling the course of one age cohort of 550,000 pupils through their schooling to the age of 16 in 29 distinct analytical steps. The steps represent stages such as what is known about each pupil when they were born, who they attended school with at age 10, and where they lived at age 14. The model also includes variables representing where data is missing for any pupil in any year. Using capped Key Stage 4 points as an outcome measure, these stages can predict the outcomes with R=0.90. This is considerably higher than for models using snapshots or summaries of disadvantage. Key predictors are special educational needs at age 5, and throughout schooling, coupled with prior attainment at ages 6, 10, and 13. With predictors fed into the model in life order, there is little evidence of differential progress for different language and ethnic minority groups, and no evidence of a regional difference or type of school effect. The paper concludes with the implications of these results for assessing disadvantage when considering school contexts, and for policy-makers. Given the small but apparently consistent negative school composition 'effects' in every year, one clear implication is that school intakes should be as mixed as possible both socially and academically.

Introduction

Measuring disadvantage

This paper looks at how we can best encapsulate indicators of pupil disadvantage when looking at relative school performance in England. Our prior work has been based on more sensitive measures of disadvantage such as duration rather than binary (yes/no) classifications (Gorard and Siddiqui 2018). One example is the duration of poverty. Using the number of years a student has been eligible for free school meals (FSM), and how segregated a school system is by poverty and other indicators of disadvantage, it is possible to explain substantive differences such as the apparently superior attainment of schools in different regions and of different types. Any policies predicated on surface differences in attainment are being misdirected. There are implications for policy in terms of regional comparisons of school performance, the 'effectiveness' of different types of schools, educational effectiveness more generally, and how we assess the clustering of disadvantaged pupils in particular schools and areas.

In England, schools have traditionally received extra funding for pupils with special educational needs (SEN), disabilities, and learning challenges. Since 2010, schools have also received additional funding proportional to the number of disadvantaged pupils they take. This funding is known as the Pupil Premium. It is partly based on a number of small categories such as living-in-care, but the vast majority is based on pupils known to be living in relative poverty according to official records. The basic indicator is eligibility for free school meals (FSM), a welfare entitlement for those pupils from families on income support and related measures. FSM eligibility is collected officially, reported to government, has a clear

legal basis, and requires documentation. It forms not only the basis for the Pupil Premium but also a useful context for school performance and national inspections.

FSM-eligibility is not a constant characteristic of an individual pupil, in the same way that age or sex usually is, but linked to the economy and family circumstances, meaning that some pupils move in and out of FSM-eligibility over their school careers (Strand 2014). It has already been established that traditional measures of FSM-eligibility have problems. A small but important number of disadvantaged pupils are missing key data on eligibility, and they are unevenly spread between schools (Gorard 2012). This can affect their education directly by denying their schools Pupil Premium share, and making their schools appear to be performing worse than they actually are using contextualised measures, in Ofsted inspections, and in calculations of the Pupil Premium attainment gap. This would make them doubly disadvantaged. In addition, using current FSM status means ignoring what Noden and West (2009, p.4) termed a 'hidden poor' of those pupils previously eligible for FSM but not subsequently. These pupils may still be suffering the impacts of earlier disadvantage. Partly for this kind of reason, the DfE now produces a measure 'EverFSM6' which covers pupils both currently and previously eligible for FSM over the last six years. This is what is now used for Pupil Premium calculations, and so for calculating the Pupil Premium attainment gap. This gap compares the results in each school for Pupil Premium pupils and the rest. A large gap is seen as a bad outcome.

However, even this may not be enough. EverFSM6 still ignores pupils in secondary school who had been eligible more than six years previously. This 'invisible' group has attainment results that are in some ways more similar to the EverFSM6 pupils than those who have never been eligible. This is an argument for extending the analysis over more than six years. Also all EverFSM6 pupils will trigger receipt of Pupil Premium by their schools, but their absolute level of deprivation may vary considerably in a way that is subsequently linked to their attainment. There are marked differences between those currently FSM-eligible and those not currently eligible but who are EverFSM6, as there is between both of these groups and those not eligible at all in the last six years. The not currently eligible pupils are closer both in other characteristics (such as ethnicity) and in attainment to those who have never been eligible than the currently eligible pupils are. This makes using the Pupil Premium attainment gap intrinsically unfair, by favouring those schools or regions with more pupils moving across the threshold, and fewer who are FSM-eligible year after year (Gorard 2018). Therefore, analyses have been run, and found to create stronger predictive models, using the number of years that any pupil is known to have been FSM-eligible (Gorard and Siddiqui 2018). The same approach is also used in this paper for other indicators of possible disadvantage such as SEN.

There are possible alternatives to FSM as an indicator of family disadvantage. Taylor (2018) found that parental education was a better predictor of later attainment than FSM, and in fact that there was almost no relationship between FSM and attainment in Wales. However, this is almost certainly an artefact of using a small dataset with relatively high attrition and missing data (the Millenium Conort Study). Driesseni (2017) found that parental education was not a good long-term indicator of disadvantage for allocating weighted financial resource in the Netherlands. They suggested that the actual performance of students based on test achievement and teacher observations may offer a more valid alternative. In England FSM is more complete than its alternatives, and where comparisons have been made there is no good substitute even considering parental income, education and other factors (Gorard et al. 2017a).

Segregation between schools

A related issue is the clustering of poverty within particular schools. Pupils from poorer backgrounds have substantially lower attainment in the US, UK and around the world; and they make negative progress compared to the other students while at school, meaning that the poverty gap widens (Rutkowski et al. 2017, DfE 2017). Schools can make these inequalities worse through their method of allocating places to

pupils. In England, around 30% of students would have to exchange their schools if SES and related segregation between schools were to be eliminated. Evidence from around the world shows that such segregation is unnecessary, and harmful to students (Gorard 2018). It is associated with greater unfairness in practice, worse opportunities for the most disadvantaged, lowered aspirations, and lower participation rates in later education (Schmidt et al. 2015). It may reduce tolerance and understanding between the segregated groups (Platt and Burgess 2018). And all of these risks are run by the system for no clear gain.

The clustering of students with similar characteristics in particular schools is partly determined by factors outside education, indeed often outside immediate government control. The economic cycle, the nature of regional populations, residential segregation within regions, local population density, the quality of public transport (especially in rural areas), and patterns of recent immigration are all determinants of either the level or trend in SES and other forms of segregation between schools. Other determinants are quite clearly within education and within government control. The policy of inclusion for children with disabilities and learning challenges and the growth of diagnoses for non-visible disabilities have led to a general decline in segregation by SEN. The allocation of over-subscribed school places in terms of catchments, distance or feeder schools exacerbates or at least retains the impact of existing residential segregation (Saporito 2017). Policy solutions include area-wide bussing, banding or local authority lotteries, combined with free travel, for those entitled, to any feasible school rather than simply to the nearest available. However, the biggest single controllable factor is the diversity of national school provision.

The quality of education available in a national school system should not depend upon where a student lives or which school they attend. Therefore, new school types or schemes for only *some* pupils are not the way forward. Comparing within the same areas, and so not determined by regional differences in poverty, faith-based and grammar schools take many fewer poor pupils than expected (DfE 2017). The poverty gap in education will more likely be reduced by reducing differences between schools, opportunities and treatments, than by celebrating them. There should therefore be no state-funded diversity of schooling, with the state wilfully continuing to provide what they claim (by implication) is an inferior experience for some. For example, if grammar schools were clearly better schools then their advocates are effectively arguing that the 80% of local pupils in secondary-modern schools or the 100% in areas without grammar schools should be condemned to an inferior education by the state. In fact, it is not clear that that any type of school is better than any other, and so the money invested in them could have been used more fruitfully elsewhere. All young people should be included in mainstream institutions as far as possible. Controlling the school mix like this is one of the most important educational tasks for central and local governments – but it is one that they routinely evade (or worse).

School effects?

School composition 'effects' linked to this segregation between schools appear once individual variation has been accounted for, and when the school average prior attainment or pupil background is still linked to individual pupil attainment. This composition effect might suggest that pupils in high attaining schools do better than expected or that pupils in very disadvantaged schools do much worse than expected. If accepted, this has implications for policies on allocating school places. Composition effects appear stronger where the sorting of pupils into different tracks by ability is stronger (Danhier 2017).

However, much of the literature suggests that composition effects are small to non-existent (Gorard 2006a). Relative attainment between stages of schooling is very stable over a pupils' school career, even when their home and SES background changes. There is therefore a high correlation between pupils' school grades in successive years, and this means there should be little scope for strong composition 'effects' (Marks 2018).

There is a reported danger of under- or over-estimating school compositional effects due to measurement error, making them appear as phantom results (Televantou et al. 2015). Pupil-level measurement error, even if it is random in nature, can produce spurious school-level compositional effects. As pupil data becomes less reliable it picks up less of the variation in outcomes, but the aggregate school figures are more tolerant and so now pick up some of that variation (Gorard 2006b). And "correcting for prior attainment at pupil-level is insufficient to produce unbiased school value-added estimates" (Perry 2018, p.7). Perry (2018) suggests adjusting regression models of school performance for the school average outcomes, and demonstrates why - based on value-added analyses in England over time. In years when VA models were corrected for school-level outcomes then the correlation between VA and raw scores was lower, as it should be. Otherwise it was high at 0.7 or more, meaning that value-added was not an estimate of independent progress made by pupils. Correcting for school-level as happened in England up to 2010 is also linked to a much lower bonus, if any, for attending a selective grammar school. Such large changes in value-added scores and their correlations with raw-scores, as happened from 2010 to 2011, are unlikely to be linked to true school performance, and are more likely to do with changes in measurements and modelling. As with improved measures of disadvantage (above), this has implications for measuring the supposed performance of schools net of their pupil intake, and for claims about the superiority of different types of schools in England such as Academies, Free schools, faith-based and grammar schools.

Regional comparisons

In England, policy-makers frequently make comparisons between school outcomes in different regions, and use these to direct policy and funding. For example, the former Chancellor George Osborne and the former Chief Inspector of Schools in England Michael Wilshere have both stated that attainment at age 16 is too low in the North of England (The Guardian 2016, 2017). According to Ofsted (school inspectors), there are more than twice as many secondary schools judged inadequate in the North and Midlands compared with the South and East. Such claims influence policy in and beyond education, including whether to improve transport links in the North (Financial Times 2016). According to the CBI (employers' federation) after "an analysis of official statistics", ensuring that pupils get good GCSE or equivalent qualifications would be the most effective way of tackling productivity differences across the UK, rather than prioritising faster road and rail links in the Midlands and north of England as the government had planned to do. This has led to demands that schools in low attaining areas like the North of England should improve so that they are not letting their pupils down. A frequently used example of how to do this is the London Challenge, which was supposedly successful in raising the attainment of poor pupils even in heavily disadvantaged authority areas (Hutchings et al. 2012).

These claims about regional differences in school performance are examined in the model that follows in this paper. However, it is worth noting that schools in London have received more funding per pupil than schools in the North for a long time, and that this funding increased further for the London Challenge. And that the London schools started their challenge with already higher attainment and a lower poverty gap. No account was taken of the economic recession leading to parents not using private schools so much and the historic differences in use of private schools between North and South. Nor was full account taken of the very different ethnic compositions of the two regions. The London results were perhaps largely the 'effect' of socioeconomic background and other geographical differences (Burgess 2014). It is not clear how successful the London Challenge really was.

Disadvantaged pupils in isolated schools in England have lower KS4 results than in non-isolated schools, whether in North or South, despite rural areas having school attainment at least as high as in urban areas where there is more disadvantage (Odell 2017). In summary, although policy is often directed at a regional level, the region, authority, or district of school attended has little or no relevance for pupil attainment in the UK (Henderson 2008).

All of these issues are investigated further in the research that follows.

Methods

The research presented here is based on the National Pupil Database (NPD) for England – specifically the 2015 Key Stage 4 (KS4) cohort, with attainment, school and background information for every year that they were in compulsory schooling. There were 549,186 pupils with relatively complete records. Of the original 549,203 pupils in state-funded schools, 15 were missing all KS4 attainment data, and a further 2 were missing school identifiers. The remaining 549,186 cases still had some missing data, mostly where the pupil had previously not been part of the state-funded sector in England (perhaps moving to England from elsewhere). Most variables had little or no missing data for KS4, but missing data increased for records of pupils' prior years at school. For example, 668 of the KS4 cases were missing KS2 attainment data, and 181,111 were missing KS1 attainment data. The latter, along with the primary-age Index of Deprivation as a Child Indicator (IDACI), was the worst example of missing data. On the other hand, by Year 11, there were no missing values at all for pupils' sex, or their month of birth.

For all categorical background variables, such as whether a pupil was identified as having a special educational need (SEN) in any year, a further flag variable was created for that year recording whether each pupil was missing a value for that measure. Pupils with missing data are often very different from the average and this has to be taken seriously in analysis (Gorard 2012). Cases with missing values cannot simply be deleted as this would lead to high attrition and a huge potential for bias (Gorard 2010). The missing values in the original version of the variable were recoded as 'not known' as having a SEN or other indicator of possible disadvantage. For all real-number variables, such as KS1 attainment scores, any missing values were noted, and replaced with the national average for that cohort. This is not entirely satisfactory but is judged to be the best way to retain all cases, without ignoring missing values, or unduly affecting the results of the models used. Trying to 'predict' missing scores using the data that is available is more likely to bias the results than using the average.

Similar analyses to the ones described here have been conducted with the 2014 and 2016 KS4 cohort, with the same substantive results. However, the 2015 dataset has the most complete set of derived variables. The results presented here are for the KS4 capped (equivalent to the newer Best 8) GCSE or equivalent scores. The cap prevents the distortion created by differential qualification entry rates between areas of the country or sectors of schooling with more funding to pay for more entries. However, all models have also been run with the total GCSE or equivalent scores. The results are substantively the same, but with a slightly lower R value for each step.

The version of NPD used in this paper included all of the background and attainment variables, except those that are very sensitive (such as living-in-care) or most disclosive (such as the most detailed SEN or ethnic group information). The explanatory pupil-level variables include:

Attainment

- KS1 points score – attainment at age 7
- KS2 points score – attainment at age 11
- KS3 levels – attainment at age 14

Pupil characteristics

- Birth month and year – used to compute age in year
- Sex of pupil – still recorded as a binary in 2015
- FSM-eligibility – a flag variable showing whether a pupil is from a home officially classified as having an income below the poverty line

- Ethnic origin or group (major)
- English as an additional or second language
- Special needs with or without a statement

School and home

- School type attended
- Local authority area of school and home
- IDACI score – a measure of average deprivation for the area where the pupil lives or goes to school
- Whether the pupil moved to the current school in the last two years

These variables were examined for each of the 11 years from pupils entering primary school up to end of KS4 (2004/2005 to 2014/15 academic years). Some values were constant or near constant over time, such as sex or month of birth, and these were cleaned and only one copy used. Some such as school attended or area of residence changed over time, notably when pupils moved to primary schools. Some, such as EAL or ethnicity, show the development over time of the official system of identification or of the pupils themselves. These changes are mapped and examined in more detail in Gorard et al. (2017b).

New variables were created from those available in NPD, usually by combining two variables or summarising changes over the school career. Apart from new variables flagging all missing data, the pupil and school-level variables derived from the data include:

Attainment

- Mean KS1, 2 and 3 scores for each school

Pupil characteristics

- The month of birth in the school year – relative age within year group
- The number of years in total a pupil was eligible for FSM, or identified as EAL or SEN, up to KS2, 3 and 4
- Flag variables representing each category of ethnic group (Major), SEN or not, and SEN statement or not, for each year
- Flag variables representing whether a pupil was FSM-eligible for every year of their schooling

School and home

- The number of pupils, and the number of pupils in each background category, in each school
- The between school FSM-segregation residual, for each school
- The between school segregation residual of pupils always identified as FSM-eligible, for each school
- Flag variables representing school type, such as Academy Converter or not
- Economic region of England
- Whether a pupil attended school in the same local authority as residence
- Whether a pupil attended school in an area with grammar schools

The ethnic group categories of other, mixed and unclear are all re-classified as other. The between school segregation residual for FSM-eligibility is the amount by which each school's intake deviates from the national average (using the GS index). In this case, it is the difference between the number of FSM pupils in each school cohort divided by the number of FSM pupils in that cohort in England, and the number of all pupils in each school divided by the number of all pupils in England (Gorard et al. 2003).

All possible predictor variables were considered in terms of their link to KS4 attainment scores. Real number predictors were correlated with KS4 attainment using Pearson's R coefficients, and the mean KS4 attainment was compared for each category of categorical variables. The latter were converted to 'effect' sizes by dividing the difference between means by their overall standard deviation.

A regression model was developed over a considerable period to create a result with the largest R value ('effect' size), but the fewest, simplest set of predictors with relatively stable coefficients. For this reason we did not include interaction terms, even though they are theoretically interesting, and increase R values very slightly. They are also hard to interpret. Having fewer predictors not only simplifies the eventual explanation, it also considerably reduces the problem that best-fit regression models can find spurious explanations with even random 'predictors' as long as the number of predictors is high relative to the number of cases (Gorard 2006b). And it reduces any problems caused by collinear predictor variables, such as predictors changing sign unexpectedly.

The outcome or 'predicted' variable is the KS4 capped GCSE (or equivalent) score for each pupil. Prior attainment scores are clearly linearly related to the outcome scores, as are the other real number variables such as IDACI scores. Most of the other predictors are dummy or flag variables, such as eligibility for FSM or not. The predictors were added to the model in groups representing years at school, including everything that was known about the pupils at that time. For each year, individual data were entered first, followed by school-level aggregates. Therefore, the first group included the sex and age-in-year of the pupil, plus other background variables for 2004/2005 such as ethnic group, EAL, SEN, and FSM, whether any of these was missing for that year, and then the school and home terms for that year. A further step was included after the background data for any year that represented the end of a Key Stage – including the KS1, KS2, and KS3 attainment scores for pupils and schools. At end of KS4, variables were added representing summaries such as the number of years a pupil had been identified as EAL. Variables were then added representing regions of England and type of school attended.

Many of the flag variables, such as SEN status, are used for each year. The values for any pupil can move between the two states every year, and so this analysis is similar to a lagged approach. Results are shown for each step, including the impact that each new variable or set of variables makes to the overall model. The 2005 dataset provided did not contain ethnic group or SEN. Therefore the 2006 ethnicity and SEN data are used for the baseline in Year 1. This makes the model appear to suggest that Year 2 variables are less correlated with the outcome than their equivalents in other years. This should be ignored – or perhaps the Year 1 and 2 background variables should be envisaged as only one step in the model. Entering the predictors like this clarifies the key possible determinants of KS4 attainment at school, in strict biographical order (so that later values cannot act as proxies for earlier ones).

The eventual model is not any kind of definitive test, and any correlations with the outcomes do not necessarily imply causation (although absence of correlation does imply no causation). In development, each variable was added to and removed from the model individually and the results checked for changes in R and substantial changes in coefficients. Those that made no difference (to four decimal places) were omitted. Separating the variables into more or fewer steps, using fewer variables, and handling missing data differently, all lead to slight differences in the sizes of R and the coefficients. However, the main model presented is tolerant of changes, and minor changes in format do not lead to unexpected changes of the sign of the coefficients, for example.

The data represent all pupils in state-maintained schools in England (for whom there is an official record). Therefore, issues such as statistical generalisation, clustered standard errors, and significance testing are not relevant to any part of this paper.

Predictors of KS4 attainment

Looking first at some of the missing data, it is clear that any data missing on pupil characteristics is linked to poorer attainment outcomes (Table 1). This is true for any year, and the link is strongest when pupils are in Year 10 (2014). The 'effect' sizes, especially for FSM and SEN, are large. In fact, they are among the largest found in the data. There are several possible reasons for this. It is partly that NPD returns are sometimes less complete outside mainstream maintained schools. But the gaps remain even if only mainstream schools are included in the analysis (pupils missing FSM data attain 204.21 KS4 points on average, for example). It is partly about moving to a new school. But the gap remains even if those listed as moving to their KS4 school in the last two years are ignored (pupils missing FSM data attain 210. 41 KS4 points). Pupils missing data may be from particular ethnic groups such as Travellers (not disaggregated in this dataset), and 1.4% of ethnic minority pupils are missing FSM data compared to 0.4% of White UK pupils. They may be recent immigrants or refugees without relevant documentation. However, even combined these explanations are not sufficient for the scale of the difference. Pupils missing data represent a kind of disadvantage (Gorard 2012). Ignoring them or making them invisible though imputation or similar is both invalid and unfair. Missing data is used as an extra category for each relevant variable in the regression model that follows.

Table 1 – Comparison of means for missing data

Category	Yes	No	"effect" size
FSM missing Year 10	199.10	312.23	-1.16
SEN missing Year 10	199.10	312.23	-1.16
Language missing Year 10	228.12	312.15	-0.86
Ethnic group missing Year 10	270.31	312.20	-0.43

Overall standard deviation=97.77

Looking at the known background characteristics of pupils, only having a statement of SEN yields an 'effect' size at least as great as for missing data (Table 2). It is interesting that the differences between those with and without a statement of SEN remain relatively constant over the entire school career, and are the same in Year 11 as in Year 1. The same is true of SEN without a statement, eligibility for FSM, and ethnic group. Although individual pupils vary in terms of SEN, FSM and ethnic group (as labelled) throughout their school career, the 'effect' sizes for these variables remain just about the same. Unsurprisingly, pupils identified as having SEN or eligible for FSM have considerably lower scores than their peers, on average. In general, ethnic minority groups have slightly higher attainment than White UK pupils, although Black pupils have very similar attainment to White UK pupils.

Table 2 – Comparison of means for background characteristics

Category	Yes	No	"effect" size
Male	298.33	325.24	-0.28
FSM Year 1	255.40	322.50	-0.69
FSM Year 11	249.34	321.47	-0.74
Always FSM	238.40	314.96	-0.78
EverFSM	265.03	331.96	-0.68
SEN no statement Year 2	239.10	326.56	-0.89
SEN no statement Year 11	236.02	322.20	-0.88
SEN statement Year 2	114.11	315.06	-2.06
SEN statement Year 11	116.25	319.03	-2.07
EAL Year 1	326.82	309.66	0.18
EAL Year 11	312.77	311.31	0.01
Ethnic minority	319.48	309.57	0.10

Ethnic group Black Year 2	310.92	311.54	-0.01
Ethnic group Black Year 11	306.88	311.75	-0.05
Ethnic group Asian Year 2	328.16	310.17	0.18
Ethnic group Asian Year 11	325.84	310.11	0.16
Ethnic group Chinese Year 2	381.11	311.33	0.71
Ethnic group Chinese Year 11	375.75	311.28	0.66
Ethnic group other Year 2	318.50	311.21	0.07
Ethnic group other Year 11	316.71	311.21	0.06

Overall standard deviation=97.77

The 'effect' sizes for always being FSM eligible and being eligible for at least one school year are similar, and for being FSM eligible in any one year. EverFSM is a better predictor of attainment than EverFSM6 (whether eligible in the past six years). Males have worse school outcomes than females, on average. Unlike ethnicity or SEN, not having English as the first language at home is not linked to lower attainment. At the outset, it is linked to slightly higher eventual attainment and eventually it makes no difference to as a predictor at all.

As is well-known, pupils who are younger in their year tend to have lower attainment, although the correlation is small here (Table 3). Going to school with pupils for whom English is not a first language, is linked to higher attainment, as is going to a larger school (but only in the secondary phase). Otherwise, summaries of the characteristics of pupils in school are linked to lower attainment. Attending a school with more SEN or FSM pupils, and where these pupils have been so labelled long-term or always, is linked to markedly lower attainment. The pattern for how long other pupils in a school have been listed as SEN (of any kind) is substantial. Whether this represents the basis for a school composition effect is explored later. In general, figures for segregation such how far from fair share of FSM-eligible pupils a school takes are better predictors of individual attainment than how many FSM-eligible pupils there are in a school. The figures for Year 11 show the largest "effect" size, and are presented here.

Table 3 – Correlations between individual and school-level characteristics, and KS4 attainment

Predictor	Correlation
Month in year	-0.043
Number in school Year 11	0.150
Years EAL	0.049
Years SEN any	-0.571
Years FSM	-0.314
Segregation school Year 11	-0.211
Years FSM mean	-0.304
Always FSM mean	-0.278

Some reasonably large correlation "effect" sizes also appear for prior attainment (Table 4). The total or average KS points are always much better predictors than the individual subject scores (such as for English or maths, although maths is a better predictor than English or science). The "effect" sizes grow with each KS, as the pupils approach KS4. They also grow for the average school points per pupil, even including KS4 itself. If average school attainment is used to adjust for individual measurement error (see above), this suggests that even average attainment at KS4 could be used in modelling KS4 attainment. This is not done in the main model presented below, but was done as an additional analysis. One purpose of the model is to assess the extent to which other and subsequent factors contribute to KS4 attainment once prior attainment is controlled for.

Table 4 – Correlations between individual and school-level prior attainment, and KS4 attainment

KS1 average points	0.554
KS2 average points	0.720
KS3 total score	0.753
KS1 average points mean	0.292
KS2 average points mean	0.376
KS3 total score mean	0.438
KS4 capped points mean	0.550

The level of deprivation in the local area of residence (the Index of Deprivation as a Child Index) is linked every year to KS4 attainment – the strongest link being a correlation of -0.229 for Year 11. Schools in poorer areas have lower average attainment, and to a certain extent so do pupils at this schools, of course. However, other than that, area of residence in relation to school is not correlated highly with KS4 attainment (Table 5). For example, pupils have slightly higher attainment in grammar school areas and slightly lower in the NE of England. Both of these small differences are the bases for current policies on school 'improvement', and so it is important to see whether they are solely due to the nature of local populations. As discussed under missing data, pupils arriving at their school just before KS4 may be somewhat under-prepared or otherwise disadvantaged. Crossing a local authority boundary to attend school at primary age is linked to slightly worse subsequent attainment, but not at secondary age.

Table 5 – Comparison of means for area of residence

Category	Yes	No	"effect" size
Grammar area	316.43	309.28	0.07
NE or not	306.30	311.72	-0.06
LA travel Year 2	304.95	311.63	-0.07
LA travel Year 11	317.30	310.36	0.07
Joined school Year 10 or Year 11	221.59	314.16	-0.95

Overall standard deviation=97.77

There are some large "effect" sizes linked to the type of school attended for KS (Table 4). The most obvious relate to special and grammar schools. Special schools are reserved for pupils with special educational needs and other learning challenges. Grammar schools are reserved for pupils who pass a set of tests at age 10-11 (the 11+) and who are among the highest attaining at that age. It is no surprise that either have very different outcomes to the average. The key question is what happens to these and other differences between school types once their pupil intakes are controlled for.

Table 6 – Comparison of means for type of school

Category	Yes	No	"effect" size
Special school	28.49	316.67	-2.95
Free/Studio/UTC	265.37	311.78	-0.47
Community school	311.11	311.61	-0.01
Voluntary controlled school	322.16	311.37	0.11
Voluntary aided school	328.86	309.92	0.17
Comprehensive	313.10	296.28	0.17
Academy convertor	331.33	295.89	0.36
Grammar	412.11	307.24	1.07

Overall standard deviation=97.77

Regression findings

Some of the patterns described so far could be due to differences in school intakes and between areas, or to some variables acting as proxies for others. In order to understand the complex inter-relationships better they are all entered into a regression model in life order.

The multiple correlation between predictor variables and KS4 outcomes grows with every year at school, from 0.546 at the start of primary school to 0.900 at the end of KS4 itself (Table 7). The first value is remarkable because this step in the model involves no direct measure of prior aptitude or attainment and is only about the personal characteristics or status of each pupil (and where these are missing). The full list of these characteristics is shown in the first part of Table 8. The same background characteristics, but updated, also add to R for each year at school, but never by as much as for Year 1. The derived school-level background variables tend to add a little more to R in each year, but have a negligible correlation once individual data is known. There is a larger increase in R whenever prior attainment scores, such as those at KS1, are added, but these decrease with each stage (presumably because at least some of what is being measured is relatively stable). Again, the school-level attainment variables tend to add a little more to R in each year, but have a negligible correlation once individual attainment data is known. There is no evidence of a substantial positive peer or school-mix effect on attainment here. Nor is there any evidence that the type of school attended is linked to attainment, once fuller pupil biographies have been taken into account. The majority of variation in outcomes that can be explained, has been explained by the final step. There is very little left for regional or school 'effects'.

Table 7 - R value for each step of the model

Year	R	Increase in R	Variables
1 (primary school start)	0.546	-	2005 background, missing values
	0.576	0.030	2005 school mean background
2 (KS1 end)	0.578	0.002	2006 background, missing values
	0.579	0.001	2006 school mean background
2 (KS1 attainment)	0.684	0.106	KS1 scores for pupil
	0.685	0.001	KS1 scores school, interaction
3 (KS2 start)	0.692	0.007	2007 background, missing values
	0.693	0.001	2007 school mean background
4	0.701	0.008	2008 background, missing values
	0.701	-	2008 school mean background
5	0.708	0.007	2009 background, missing values
	0.709	0.001	2009 school mean background
6 (KS2 end)	0.717	0.008	2010 background, missing values
	0.718	0.001	2010 school mean background
6 (KS2 attainment)	0.820	0.102	KS2 scores for pupil
	0.821	0.001	KS2 scores school, interaction
7 (secondary school start)	0.826	0.005	2011 background, missing values
	0.827	0.001	2011 school mean background
8	0.829	0.002	2012 background, missing values
	0.829	-	2012 school mean background
9 (KS3 end)	0.833	0.004	2013 background, missing values
	0.834	0.001	2013 school mean background
9 (KS3 attainment)	0.883	0.049	KS3 scores for pupil
	0.885	0.002	KS3 scores school, interaction
10 (KS4 start)	0.888	0.003	2014 background, missing values
	0.888	-	2014 school mean background
11 (KS4 end)	0.899	0.029	2015 background, missing values, summary values

	0.900	0.001	2015 school mean background, summary values
11 (KS4 type of school)	0.900	0.000	Region and type of school

For the full model, the coefficients for each step are shown both as unstandardized and standardised. The standardised versions are most useful when considering the real number variables (in italics in all tables), but perhaps make less sense with flag variables representing categories. Where the coefficient is effectively zero, or the variable has been removed as having no variation or otherwise not affecting the model, the result is displayed as "-".

For the age in year (where September birth is 1 and August is 12), the youngest pupils will attain about 11% of a standard deviation (or just over 3 KS4 points) lower than the oldest pupils, on average (Table 8). Females will attain about 16 more KS4 points than males, on average. When a young child starts school the clearest predictors of their eventual KS4 results are FSM and SEN status. Little that is done then or later changes this fact. Whatever the limitations are of using FSM as an indicator of disadvantage, poorer children can expect to attain 57 fewer KS4 points than their peers. And those with a statement of special need at the outset can expect 210 fewer points, on average. In 2015, the average KS4 points score for all pupils was 311, and the standard deviation was 98. A difference of 210 points is completely life-changing.

In general, younger, poorer, male, FSM-eligible (or missing FSM data), SEN, and White pupils (or with missing ethnicity) were predicted lower KS4 scores from their first year at school onwards, when all other variables are held constant. No pupils were recorded as travelling to primary school in a different local authority. All other groups had better average attainment outcomes, including all recorded ethnic minorities and those not known to have English as a first language. None of these categories is perfect either in theory or in the allocation of cases, and there may be pupils with poor English, or who are younger in their year, misclassified by their schools as having SEN, and so on. But the model suggests that poverty and learning challenges are key determinants, and need to be emphasised more in policy, practice, and school 'performance' measures (Gorard 2018).

Table 8 – Regression coefficients for Year 1 background variables

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
Sex of pupil	15.707	0.008
Age in year	-0.279	-0.001
FSM eligible	-57.340	-0.217
FSM missing	-12.380	-0.035
SEN statement	-209.588	-0.282
SEN no statement	-83.208	-0.321
SEN missing	-26.923	-0.073
English not first language	23.596	0.075
Language missing	9.230	0.026
Ethnic group Black	12.263	0.024
Ethnic group Asian	5.057	0.014
Ethnic group Chinese	46.735	0.025
Ethnic group other	13.376	0.027
Ethnic group missing	-0.070	-
Pupil travelled to another authority	-	-
School and area predictors		
IDACI score	-74.335	-0.132

Number of pupils in school	-0.025	-0.005
FSM level in school	-	-
FSM segregation residual for school	-63068.078	-0.052
SEN with statement level in school	-119.365	-0.087
SEN with no statement level in school	5.938	0.008

Table 8 also shows that the recorded percentage of FSM-eligible pupils in each school is not needed as a predictor in addition to the segregation residual for FSM-eligible pupils. The latter is generally a better predictor, showing by how much any school has more or less than their fair share of FSM-eligible pupils. As noted above, although the increase in R is small, pupil's attainment is generally slightly worse in schools that take more than their fair share of FSM-eligible pupils. It is also slightly worse, on average, in larger schools at this primary stage, and in those with high levels of SEN pupils. This is likely to be linked to the existence of special schools in some areas, and to differences in the levels of challenges faced by pupils with statements (a point returned to later).

In Year 2, using the same updated variables, many make no difference to the outcome presumably because they repeat much of the same information as for Year 1 (and, as noted above, there are no distinct measures of SEN or ethnicity from 2005). Those variables retained in the model all have a lower absolute coefficient (Table 9). FSM eligible pupils in primary school Year 2 are still predicted to attain 23 KS4 points less than their peers, after controlling for all other variables, including their FSM status in Year 1. Similarly, living in a more deprived area (IDACI score) is still linked to lower subsequent attainment.

Table 9 – Regression coefficients for Year 2

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-22.837	-0.083
FSM missing	-	-
SEN statement	-	-
SEN no statement	-	-
SEN missing	-	-
English not first language	10.538	0.034
Language missing	-0.993	0.003
Ethnic group Black	-	-
Ethnic group Asian	-	-
Ethnic group Chinese	-	-
Ethnic group other	-	-
Ethnic group missing	-	-
Pupil travelled to another authority	-7.463	-0.010
School and area predictors		
IDACI score	-40.501	-0.072
Number of pupils in school	0.099	0.021
FSM level in school	-0.290	-0.023
FSM segregation residual for school	-	-
SEN with statement level in school	-	-
SEN with no statement level in school	-	-

Note: SEN and ethnic group variables missing for this step

Table 10 shows the results from introducing the first set of prior attainment results - at KS1. The correlation between KS1 and KS4 points is the largest of all single predictors so far. However, on average pupils do less well than other variables would suggest when they are in schools with higher KS1 points

Table 10 – Regression coefficients for KS1 Attainment

Variable	Unstandardised coefficient	Standardised coefficient
KS1 average points	12.352	0.408
School mean KS1 average points	-2.543	-0.037

By Year 3, whether a pupil is missing a value for FSM-eligibility no longer helps to predict KS4 attainment, but missing SEN data still does. The picture for missing SEN from Year 1 to Year 11 is relatively simple. The coefficients for missing any of these data are always negative, and they do not decline over time as might be expected (Table 11). There are more missing values in Year 1 than Year 11, and once the status has been used as a predictor in 2005, one would expect the link to attainment to reduce over time. Where they appear, the missing FSM and SEN categories appear to be picking up an extra form of deprivation – those not even known to be disadvantaged. The coefficients for missing first language or ethnic group data are more generally positive for each year, smaller than for FSM and SEN, and show some signs of declining over time - from 0.075 for first language in Year 1 to 0.034 in Year 2, for example.

Table 11 – Regression coefficients for Year 3

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-14.398	-0.053
FSM missing	-	-
SEN statement	-88.940	-0.127
SEN no statement	-28.879	-0.116
SEN missing	-26.716	-0.070
English not first language	19.229	0.064
Language missing	7.931	0.021
Ethnic group Black	7.763	0.016
Ethnic group Asian	10.569	0.029
Ethnic group Chinese	35.790	0.019
Ethnic group other	9.907	0.019
Ethnic group missing	5.679	0.016
Pupil travelled to another authority	-2.484	-0.005
School and area predictors		
IDACI score	-24.746	-0.044
Number of pupils in school	0.017	0.004
FSM level in school	-	-
FSM segregation residual for school	-25831.730	-0.022
SEN with statement level in school	-53.898	-0.040
SEN with no statement level in school	-7.785	-0.010

The same annual predictors are shown again in Table 12 for Year 4 at school, and they have the same general pattern as in Table 8. Cross-border travel is only slightly negatively related to eventual attainment. FSM-eligible and SEN pupils are predicted to have lower KS4 attainment, and all ethnic minority groups (as recorded here) are still predicted to have slightly higher attainment at this stage. The apparent

relevance of current FSM status gets less over time, presumably as it is explicable by the previous year's status for many pupils, dropping from -0.217 in Year 1 to -0.008 in Year 11. However, omitting the FSM variable from any year of the model produces a substantively larger coefficient for the next year. Poverty is, as is well-known, one of the key determinants of attainment. In Table 12 a coefficient appears for the first time for the absolute level of FSM-eligibility at school level, and this replaces the FSM segregation residual. As noted above, both are not needed, and over 11 years, the segregation figure is the best predictor for eight of those years. Whichever variable appears, the message is the same. Pupils in higher FSM schools have lower attainment on average, even after their own FSM status is controlled for.

Table 12 – Regression coefficients for Year 4

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-14.514	-0.053
FSM missing	-	-
SEN statement	-93.419	-0.143
SEN no statement	-31.908	-0.131
SEN missing	-18.681	-0.046
English not first language	9.907	0.033
Language missing	0.253	0.001
Ethnic group Black	4.322	0.009
Ethnic group Asian	11.783	0.032
Ethnic group Chinese	36.423	0.020
Ethnic group other	8.020	0.017
Ethnic group missing	7.781	0.017
Pupil travelled to another authority	-2.351	-0.005
School and area predictors		
IDACI score	-21.466	-0.040
Number of pupils in school	0.049	0.011
FSM level in school	-0.281	-0.021
FSM segregation residual for school	-	-
SEN with statement level in school	-33.573	-0.025
SEN with no statement level in school	-12.072	-0.015

Table 13 confirms the results in all tables about cross-border travel. The coefficients for attending a school in a different local authority to home are always small, and so far have been negative. At primary school, EAL pupils are predicted to have higher than average eventual attainment. If not speaking English as a first or primary language is a disadvantage at school, it only appears to be a temporary one. However, as schooling continues, the pattern changes. Those still labelled as EAL by secondary school (perhaps not able to master English as well or recent arrivals in England) are predicted to do slightly worse at KS4. The coefficients change from 0.075 in Year 1 to -0.103 in Year 11

Table 13 – Regression coefficients for Year 5

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-13.896	-0.051
FSM missing	-	-
SEN statement	-91.646	-0.148
SEN no statement	-33.234	-0.138

SEN missing	-23.694	-0.056
English not first language	4.722	0.016
Language missing	8.620	0.020
Ethnic group Black	5.730	0.012
Ethnic group Asian	10.164	0.028
Ethnic group Chinese	34.948	0.019
Ethnic group other	9.519	0.021
Ethnic group missing	1.870	0.005
Pupil travelled to another authority	-2.307	-0.006
School and area predictors		
IDACI score	-16.287	-0.030
Number of pupils in school	-0.104	-0.028
FSM level in school	-	-
FSM segregation residual for school	-45065.455	-0.039
SEN with statement level in school	-61.271	-0.046
SEN with no statement level in school	-16.337	-0.019

The pattern of annual variables continues in Year 6 – the last year at primary school for most (Table 14). Pupils labelled as SEN with or without a statement are predicted to have lower attainment, for every year they are school. The outcomes are more negative for statemented pupils, as might be expected, but both sets of coefficients are substantial. For pupils with statements the coefficients range from -0.282 in Year 1 to -0.139 in Year 11. For pupils with SEN but no statement, there is no clear change over time, but a sudden drop in Year 7 when they attend secondary school for the first time (-0.148 in Year 6 and -0.043 in Year 7). Over and above this, outcomes for pupils in school with high levels of SEN tend to be lower (-0.087 in Year 1 to -0.021 in Year 11).

Table 14 – Regression coefficients for Year 6

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-14.403	-0.054
FSM missing	-	-
SEN statement	-89.720	-0.154
SEN no statement	-35.751	-0.148
SEN missing	-38.066	-0.085
English not first language	-6.064	-0.021
Language missing	13.652	0.030
Ethnic group Black	3.429	0.007
Ethnic group Asian	9.152	0.026
Ethnic group Chinese	38.034	0.021
Ethnic group other	8.503	0.019
Ethnic group missing	7.628	0.018
Pupil travelled to another authority	-2.261	-0.007
School and area predictors		
IDACI score	-11.607	-0.021
Number of pupils in school	-0.028	-0.008
FSM level in school	-	-
FSM segregation residual for school	-22818.804	-0.019
SEN with statement level in school	-39.562	-0.030
SEN with no statement level in school	-10.394	-0.012

At the end of KS2, the summary variable – the number of years a pupil has been FSM-eligible by the end of KS2 – which is so useful in snapshot analyses is redundant here (Table 15). It is covered by having annual FSM-eligibility already taken into account. This longitudinal approach would therefore be even better for future school performance measures than using the summary or snapshot versions. It is accurate and sensitive to exactly when a child lives in poverty during the school years. Over and above the annual school-level figures for FSM-eligibility, there is a coefficient for the school average of number years its pupils have been FSM-eligible.

Table 15 – Regression coefficients for KS2 end summary

Variable	Unstandardised coefficient	Standardised coefficient
Years eligible for FSM by end of KS2	-	-
School mean years eligible for FSM end of KS2	-5.780	-0.051

As with KS1 attainment, there is a strong correlation between KS2 and KS4 attainment (Table 16). Removing the two subject specific results makes no difference to the model R value (and increases the coefficient for the average points slightly). Again, given other factors, the results in schools with higher KS2 scores tend to be very slightly lower than might be expected otherwise (and vice versa).

Table 16 – Regression coefficients for KS2 Attainment

Variable	Unstandardised coefficient	Standardised coefficient
KS2 average points	11.641	0.555
KS2 English points	0.582	0.032
KS2 maths points	0.349	0.019
School mean KS2 average points	-1.474	-0.035

The apparent relevance of the deprivation linked to current residence (the IDACI score) declines steadily over time from -0.132 in Year 1 to -0.032 in Year 11. However there is a jump from the end of primary to the start of secondary schooling. By Year 6, the IDACI coefficient has reduced to -0.021 but it rises to -0.51 in Year 7 (Table 17). The pattern for the link between attainment and size of school (in terms of pupil numbers) is unclear. It is more often slightly negative at primary school – primary schools can be too small to sustain facilities and staff perhaps. But it is only -0.005 in Year 1, and -0.008 in Year 6. However, the coefficient changes to 0.011 in Year 7 – still small but suggesting that smaller secondary schools (themselves larger than primary) are linked to marginally better outcomes. But then it drops again to -0.006 by Year 11. In summary, size of school is not a key determinant of school outcomes.

Table 17 – Regression coefficients for Year 7

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-11.087	-0.042
FSM missing	-	-
SEN statement	-44.754	-0.081
SEN no statement	-10.558	-0.043
SEN missing	-50.987	-0.096
English not first language	3.678	0.012
Language missing	-0.981	-0.002
Ethnic group Black	0502	0.001
Ethnic group Asian	3.857	0.011
Ethnic group Chinese	27.296	0.016
Ethnic group other	4.623	0.010
Ethnic group missing	2.352	0.005
Pupil travelled to another authority	4.240	0.016
School and area predictors		
IDACI score	-29.798	-0.051
Number of pupils in school	0.018	0.011
FSM level in school	-	-
FSM segregation residual for school	-8205.317	-0.021
SEN with statement level in school	-21.680	-0.016
SEN with no statement level in school	-11.266	-0.012

As shown in each annual table, the pupil's ethnic group makes little difference from the outset. The coefficients for ethnic minority groups (as grouped by NPD here) are all small and generally positive. For example, the coefficient for Black pupils is 0.024 in Year 1 and 0.023 in Year 11. In Year 8, the coefficient for Black pupils only is slightly negative for the first time (Table 18).

Table 18 – Regression coefficients for Year 8

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-8.937	-0.033
FSM missing	-	-
SEN statement	-59.454	-0.110
SEN no statement	-15.350	-0.061
SEN missing	-50.324	-0.083
English not first language	-5.498	-0.019
Language missing	9.711	0.016
Ethnic group Black	-3.885	-0.008
Ethnic group Asian	1.394	0.004
Ethnic group Chinese	30.563	0.018
Ethnic group other	2.775	0.006
Ethnic group missing	0.256	-
Pupil travelled to another authority	1.853	0.007
School and area predictors		
IDACI score	-19.403	-0.034

Number of pupils in school	0.017	0.011
FSM level in school	-	-
FSM segregation residual for school	-14231.095	-0.035
Interaction pupil and school FSM eligibility	0.188	0.036
SEN with statement level in school	-65.079	-0.050
SEN with no statement level in school	-6.154	-0.006

In Table 19, for the first time and at the end of KS3, the Black, Pakistani/Bangleshi, and ethnic other categories all have a small negative coefficient.

Table 19 – Regression coefficients for Year 9

Variable	Unstandardised coefficient full model	Standardised coefficient full model
Individual predictors		
FSM eligible	-8.550	-0.032
FSM missing	-	-
SEN statement	-84.028	-0.158
SEN no statement	-18.766	-0.072
SEN missing	-60.604	-0.081
English not first language	-16.765	-0.058
Language missing	-6.446	-0.009
Ethnic group Black	-7.605	-0.016
Ethnic group Asian	-1.641	-0.005
Ethnic group Chinese	23.089	0.014
Ethnic group other	-2.428	-0.006
Ethnic group missing	3.776	0.006
Pupil travelled to another authority	0.193	0.001
School and area predictors		
IDACI score	-18.408	-0.032
Number of pupils in school	0.011	0.007
FSM level in school	-	-
FSM segregation residual for school	-3531.648	-0.009
SEN with statement level in school	-53.301	-0.041
SEN with no statement level in school	.-0.128	-

As with the end of KS2, the number of years a pupil has been FSM-eligible by end of KS3 is already covered by considering their position for each year (Table 20). Once other factors are accounted for, attending a school with more long-term poor children is linked to lower attainment.

Table 20 – Regression coefficients for KS3 end summary

Variable	Unstandardised coefficient	Standardised coefficient
Years eligible for FSM by end of KS3	-	-
School mean years eligible for FSM by end of KS3	-6.652	-0.064

As with KS1 and KS2, KS3 attainment is strongly linked to KS4 (Table 21). The link is weaker, perhaps partly because whatever is being measured is partly stable and so already covered by previous scores, and partly because KS3 is teacher-assessed in a rather different way to the other scores which are meant to be

tested and moderated to a national standard. There is a small link between higher attainment at KS4 and attending a school with lower average attainment at KS3.

Table 21 – Regression coefficients for KS3 Attainment

Variable	Unstandardised coefficient	Standardised coefficient
KS3 total score	11.731	0.423
School mean KS3 total score	-2.533	-0.054

Going to school in another authority is a negligible factor in each year. There is little or no cross-border traffic in Year 1, but otherwise there is a small negative coefficient throughout primary school. This changes, with a small positive coefficient for the five years at secondary school (0.008 in Table 22).

Table 22 – Regression coefficients for Year 10

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-6.676	-0.024
FSM missing	-	-
SEN statement	-71.131	-0.137
SEN no statement	-15.149	-0.056
SEN missing	-71.376	-0.058
English not first language	-17.314	-0.061
Language missing	-11.452	-0.010
Ethnic group Black	9.418	0.021
Ethnic group Asian	6.258	0.018
Ethnic group Chinese	47.003	0.029
Ethnic group other	6.791	0.016
Ethnic group missing	-6.839	-0.009
Pupil travelled to another authority	2.100	0.008
School and area predictors		
IDACI score	-19.923	-0.035
Number of pupils in school	0.021	0.015
FSM level in school	-0.132	-0.028
FSM segregation residual for school		-
SEN with statement level in school	-32.176	-0.025
SEN with no statement level in school	12.512	0.011

By the end of KS4, the pattern is still very similar to that at the outset. All coefficients for ethnic minority groups are small and positive. Being recorded as having special educational needs is still the best single predictor of KS4 attainment, by a considerable margin (Table 23).

Table 23 – Regression coefficients for Year 11

Variable	Unstandardised coefficient	Standardised coefficient
Individual predictors		
FSM eligible	-2.322	-0.008
FSM missing	-	-
SEN statement	-71.938	-0.139
SEN no statement	-14.125	-0.048
SEN missing	-	-
English not first language	-29.211	-0.103

Language missing	-19.665	-0.008
Ethnic group Black	10.460	0.023
Ethnic group Asian	4.668	0.014
Ethnic group Chinese	44.776	0.027
Ethnic group other	6.599	0.015
Ethnic group missing	2.000	0.002
Pupil travelled to another authority	10.861	0.041
School and area predictors		
IDACI score	-18.361	-0.032
Number of pupils in school	-0.027	-0.006
FSM level in school	-0.138	-0.028
FSM segregation residual for school	-	-
SEN with statement level in school	-27.770	-0.021
SEN with no statement level in school	5.975	0.005

Recent arrivals in the secondary school attended for KS4 assessment tend to have poorer outcomes (Table 24). This presumably includes pupils arriving from other school systems and countries who may be less prepared for the assessment, and pupils from Traveller families and others who may have had a disrupted formal education. The true picture could be worse than this, because the coefficients for missing FSM or SEN data in previous years are always negative, and the missing data can act as a proxy for pupil mobility. The coefficient for the segregation between schools of the long-term poor is negative and relatively large (compared to the usual FSM segregation residual). This again suggests that more attention should be paid in policy and school performance measures to the kinds of poverty in schools, and not just to snapshot variables.

Table 24 – Regression coefficients for KS4 end summary

Variable	Unstandardised coefficient full model	Standardised coefficient full model
Joined current school in last two years	-41.823	-0.071
Always FSM	2.430	0.005
Ever FSM	-8.083	-0.038
Ever FSM in last 6 years	-4.429	-0.020
Years eligible for FSM by end of KS4	-	-
Mean level of Always FSM in school	-52.983	-0.015
Always FSM segregation residual for school	-20856.883	-0.077
School mean years eligible for FSM by end of KS4	-11.382	-0.133

There is almost no relationship between the economic region of the school attended for KS4 and pupils' KS4 outcomes (Table 25). Once other factors are controlled for, there is no evidence here of underachievement in particular regions of England, and there is no North South divide, only differences in school populations. Any policies based on differences in school quality or effectiveness are therefore misdirected. There is also no difference between school outcomes in areas with selective (grammar) schools and others, confirming that the system of selection leads to no overall benefit for attainment. Policies based on creating more grammar school places to increase attainment more generally are therefore also misdirected. The coefficients for all school types are small and mostly negligible. The most substantial is positive for special schools (0.073). This finding has implications for continuing policies in England misdirected at changing the types of school.

Table 25 – Regression coefficients for KS4 Region and school type

Variable	Unstandardised coefficient	Standardised coefficient
School in NE England or not	0.434	0.001
School in area with grammar schools	-0.079	0.000
Community or not	0.397	0.002
Comprehensive or not	1.559	0.005
Grammar or not	4.016	0.008
Academy converter or not	0.441	0.002
Free school, Studio or UTC	8.456	0.007
VA or not	2.591	0.007
VC or not	-2.563	-0.003
Special school or not	53.907	0.073

Discussion

Limitations

The model portrayed here is not a definitive test, a causal pathway, or a full explanation of the outcomes. There will still be explanatory variables missing, measured in error, or taking up variation as proxies for others. The patterning is based on a set of 550,000 pupils, and is not intended to represent the lives of all or any of these individuals. There will also always be patterns that are unexplained by the kind of data used here, even using a *post hoc* best fit approach. Changing the specification such as the number of steps or the order of entry of variables can change the decimal places in coefficients.

However, the model is relatively stable under these kinds of changes, including the overall R, and the relative importance of types of variables. The same results appear for each cohort for which we have data. The key is not the precise value of coefficients, but the overall substantive picture when possible explanatory variables are entered in life order. If there is a causal pathway then it must run forward in time (attainment at KS3 cannot sensibly determine whether a pupil is living in poverty at age 7, for example). And where variables have no substantive input to the model then they may not be causal (but some, such as region of residence or type of school, might appear in cross-sectional analyses as proxies). What are the implications?

Measuring disadvantage

Our prior work has confirmed that considering longer-term indicators of disadvantage, rather than simply flags for current status, leads to better understanding of both disadvantage and its impact on outcomes. So, for example, the number of years a pupil has been known to be eligible for FSM is a better summary variable than either current FSM or EverFSM6. What this new work shows is that examining FSM status in sequence for every year that a child is in the school system is even better than both approaches. Using the flag variable for FSM, a regression model for KS4 outcomes has an R of around 0.72, and using years FSM the same model has an R of around 0.82 (Gorard and Siddiqui 2018). Here the model is 0.90. There are other changes to the model, but the biggest difference lies in using FSM and other indicators of disadvantage in this longitudinal way. The duration and precise pattern of childhood disadvantage matters when considering school outcomes, especially for FSM and SEN, more than the flag indicators suggest, and more than any other available indicator.

In the full model, the coefficients for ethnic group (major) are small, and removing these flag variables makes very little difference to R in each year. The values for each ethnic minority are always small and almost always positive. In terms of attainment and progress at school, ethnic minority status as measured here, is not a key determinant. There *are* raw-score ethnic attainment gaps, but they may be a proxy for other determinants such as SES and first language, plus temporary unfamiliarity with the system for any new arrivals in England. The DfE (2017) also concluded that differences between ethnic groups were almost entirely linked to family income. Disaggregating Asian pupils or Black Caribbean and Black African pupils might alter this picture. But no equivalent longitudinal analysis of a full age cohort has been done with theses more detailed categories. For the present, we must assume that average attainment and school progress are the same for pupils who differ only in terms of their ethnicity.

Having a first language other than English is similarly no long-term barrier to progress. In general, EAL pupils in Year 1 are predicted to obtain slightly higher KS4 scores than their peers. The problem, if there is one, may be short term, which is why pupils (still) labelled EAL in Year 11 appear to do slightly worse than their peers.

Missing data

The coefficients for missing disadvantage data are larger than for ethnic groups. In Year 1, the largest coefficient for ethnic group was 0.027 for 'Other', while missing FSM data had a coefficient of -0.035, and SEN missing was -0.073. Neither is large, and the coefficient for missing FSM data reduces with each year, partly as the amount of missing data declines. The coefficient for missing SEN data grows in the primary years and is always an issue. Missing data is partly a result of simple mobility. Pupils arriving from other home countries or from outside the UK will not have data for earlier years at school. The same applies to pupils transferring from private schools in England. There is no reason to assume that any of these groups are disproportionately disadvantaged. They may have to adjust to a new curriculum, but the model outcome is 11 years after the coefficients from Year 1, and differences in curriculum are unlikely to have such a long-term impact. Some groups such as Travellers (not disaggregated as an ethnic minority in the data) may move schools regularly, and for them missing data could represent the official statistics still catching up with the changes. As shown in Table 24 for Year 11 only, moving between schools is associated on average with a small penalty in terms of KS4 outcomes. Some groups may be refugees who do not have the necessary documentation in order to be known to be eligible for free school meals. Again, these would tend to be at least temporarily disadvantaged. Where young children have a learning challenge or disability that has been undiagnosed so far, meaning that assistance is not made available, this could reduce their chances of progress in the early years, and so of higher attainment at KS4.

Missing ethnicity or first language data in the early years is not linked to lower outcomes, presumably because neither factor is key to attainment, and so unidentified EAL, for example, is not linked to lower progress once all other factors are taken into account. Nevertheless, missing data matters, and for FSM and SEN it is a serious concern. There would be a danger is using missing data routinely in predictive performance models, that it would encourage games-playing by schools or individuals (Gorard et al. 2017a). However, it ought to be taken into account more in researching school intakes and contexts (Gorard 2012).

School composition effects

The model presented here is not able to decide definitively whether there is a peer effect at school level. The model does clarify that the FSM segregation residual for each school is a better predictor of outcomes than the simple percentage of FSM-eligible pupils. Segregation here is the distance from a fair or evenly distributed school intake, assessed by the GS index (Gorard et al. 2003). As with longitudinal measures of disadvantage, it would be better for future consideration of school intakes to use the segregation residual.

However, the total R increase due to school (and area) factors in each year is small, and almost negligible in comparison to individual measures.

Whether school composition is a phantom or not, the school-level variables tell a consistent story across the duration of schooling. Pupils do worse in schools with clusters of disadvantage or clusters of prior attainment. Put another way, if this composition is real then schools should be as mixed as possible both socially and academically. This could lead to improved outcomes of between 0.05 and 0.15 of a standard deviation for almost no cost. No new schools need to be built, no new teachers employed, no new buildings or resources - just a more even spread of pupil intakes than currently by changing the school allocation process over a number of years. And even if it make little or no difference in practice it may have other benefits (see above).

Area of residence

Once pupil intake characteristics and prior attainment are accounted for, there is no evidence here that schools in different economic regions have different outcomes for equivalent pupils. This is important because a lot of current education policy in England is concerned with surface regional differences in attainment and either crediting schools for their results, as in the London Challenge, blaming schools for their failure, as in comments to the Select Committee about the North South divide, or simply where more work is being proposed, such as in supposedly underperforming coastal areas. As with so much in education, policy-makers appear to be reacting to raw-score differences linked to differences in regional populations rather than the performance of pupils, schools and teachers. Poorer areas of England need investment and infrastructure, not better schools in particular. Education is not a cheap solution to economic disadvantage.

There is no benefit for pupils from living in an area that has retained grammar schools, and their counterparts – the neighbouring or secondary-modern schools that lose the highest scoring pupils. This is not a better system than in other areas, and does not lead to greater attainment for equivalent pupils. Again, this has implications for current government policy, which is being so misled by raw-score results. Pupils attending schools in local authorities other than their area of residence do not gain systematically higher outcomes. The coefficient for the deprivation of area of residence (IDACI score) in Year 1 is -0.132, whereas the coefficient for school segregation is -0.052. Removing IDACI as a predictor in each year does not reduce the total R of the model. Instead the coefficient for school segregation changes to -0.119 without any obvious changes in other school or area variables. Local and school-level poverty are inter-correlated to a considerable extent.

School type

As shown in Table 25, there is no such thing as a substantial school type effect. Schools are largely defined by who attends them. Once that is accounted for, there is no great difference between the outcomes of any of them (coefficients of 0.002 to 0.008). Only special schools (coefficient 0.073) might offer any advantage to the subset of pupils with greatest need. But even this could be a phantom composition effect, and is not stable enough to base policy on. For example, it is not an argument against the inclusion of SEN pupils in mainstream settings for other reasons. Every new administration in England seems to want to create a new type of school for only some pupils or some parts of the country. Recently it has been Academies, Free schools, Studios and UTCs, faith-based and selective schools. None of these have better results than community, comprehensive schools, and some cost a great deal more.

Overall, the findings mean that when policy-makers, advocates of the success of the London Challenge, the inspection regime Ofsted, awards committees and others use the pupil premium gap as a measure of success they are probably and unwittingly being very unfair. There is a problem for all such pupil

premium attainment gap calculations caused by missing data, and because they take no account of the proportion of local residents using private schools (both influencing the calculation by their absence). They are also unfair because they do not take account of the threshold nature of FSM-eligibility. They are ignoring the variation *within* that category stratified by prior educational challenges like SEN and EAL, and then again by the qualification outcomes used to calculate the gap. Almost as importantly, our prior analysis shows that different areas have different proportions of types of FSM pupils such as the long-term poor. Heavily disadvantaged areas are likely to have more of the always FSM-eligible pupils, and this makes any comparison with other areas based on the pupil premium gap intrinsically invalid (Gorard 2018). This is in no way an argument against the pupil premium policy itself, but it does suggest that the impact of the policy needs a rather more robust evaluation than simply measuring changes in the pupil premium attainment gap.

Acknowledgements

This work was funded by the ESRC, now part of UKRI (grant number ES/N012046/1).

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